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(43) Application published 12 Sep 1984

(21) Application No 8305937

(22) Date of filing 3 Mar 1983

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D21G 1/00

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None

(58) Field of search
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D1A
D1S

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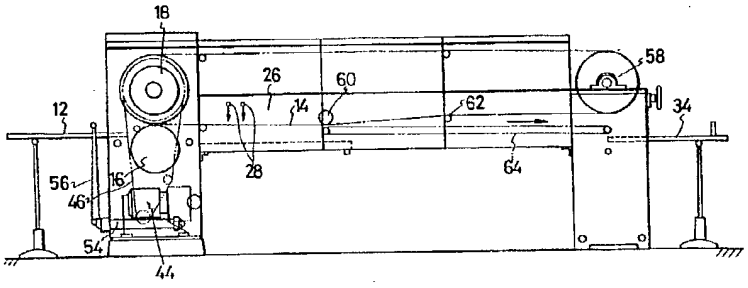
# (54) Calendering sheet paper

(57) Sheet paper covered with synthetic resin is inserted between a metallic endless belt 14 and press roller 16. The metallic endless belt is wound around and heated by main roller 18 in which a thermal fluid such as steam of oil is circulated. The sheet paper heated by conductive heat of the thermal fluid is then cooled by the endless belt 14 which is cooled by cold water shower 28 and, finally, the sheet paper is peeled off from the endless belt.

In this way, construction of calendering apparatus can be simplified and an improved heat control can be realized. Furthermore, the sheet paper covered with synthetic resin can uniformly be heated and, thereby, calendering effect can be enhanced.

FIG. 2

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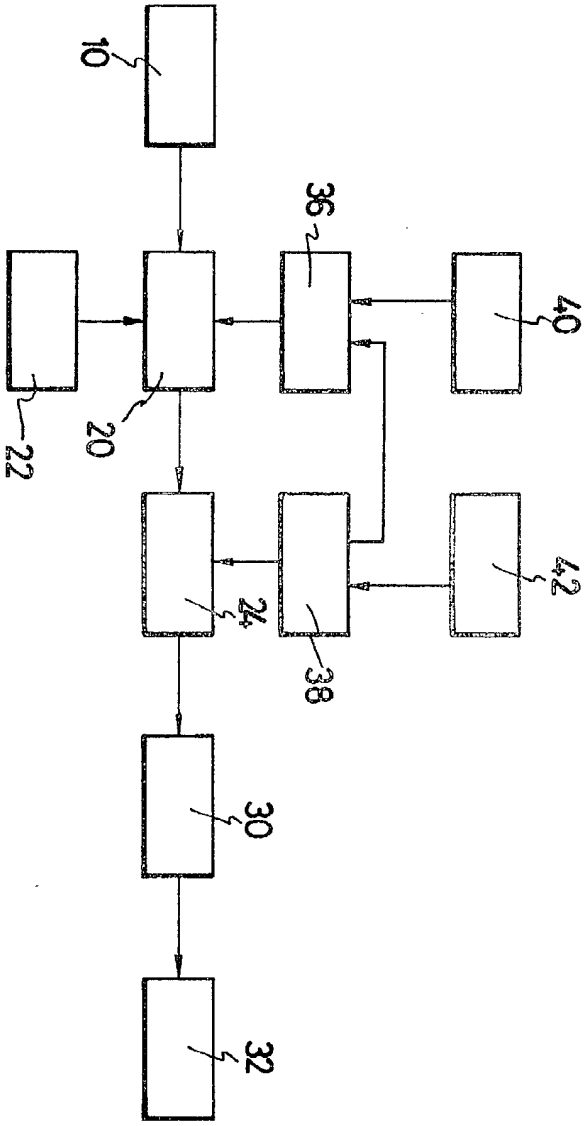


FIG. 1

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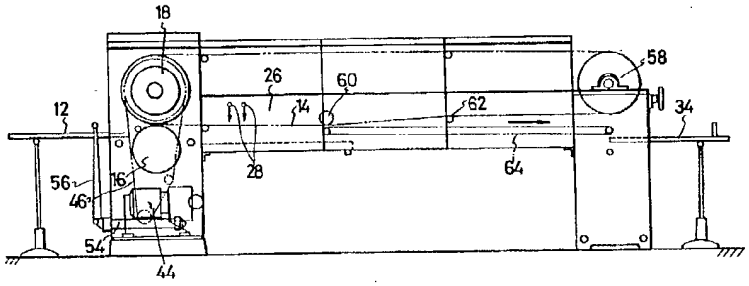


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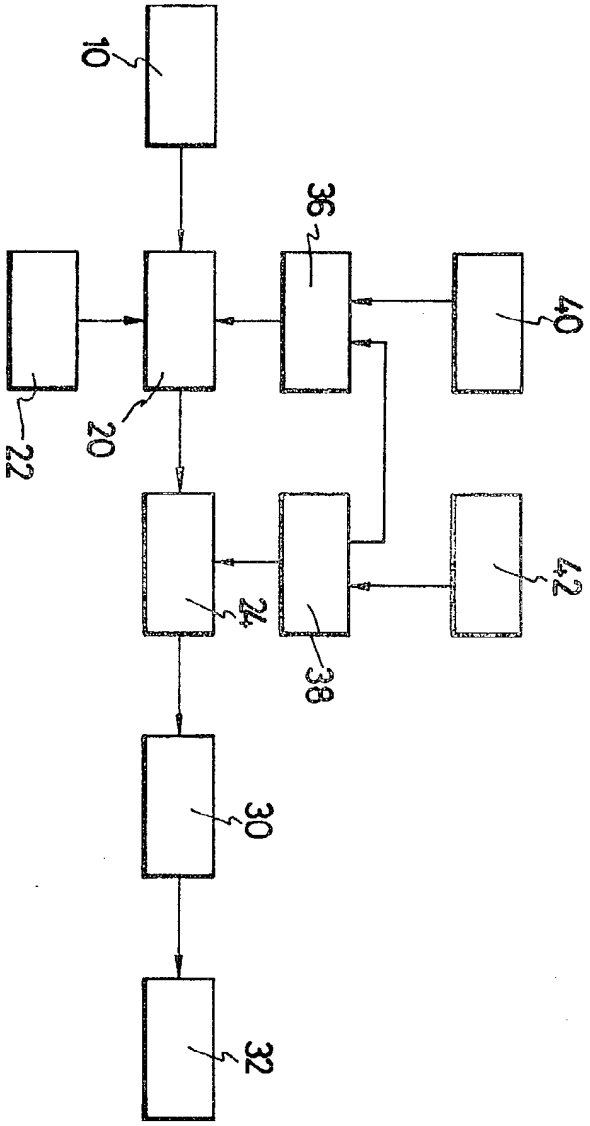


FIG. 1

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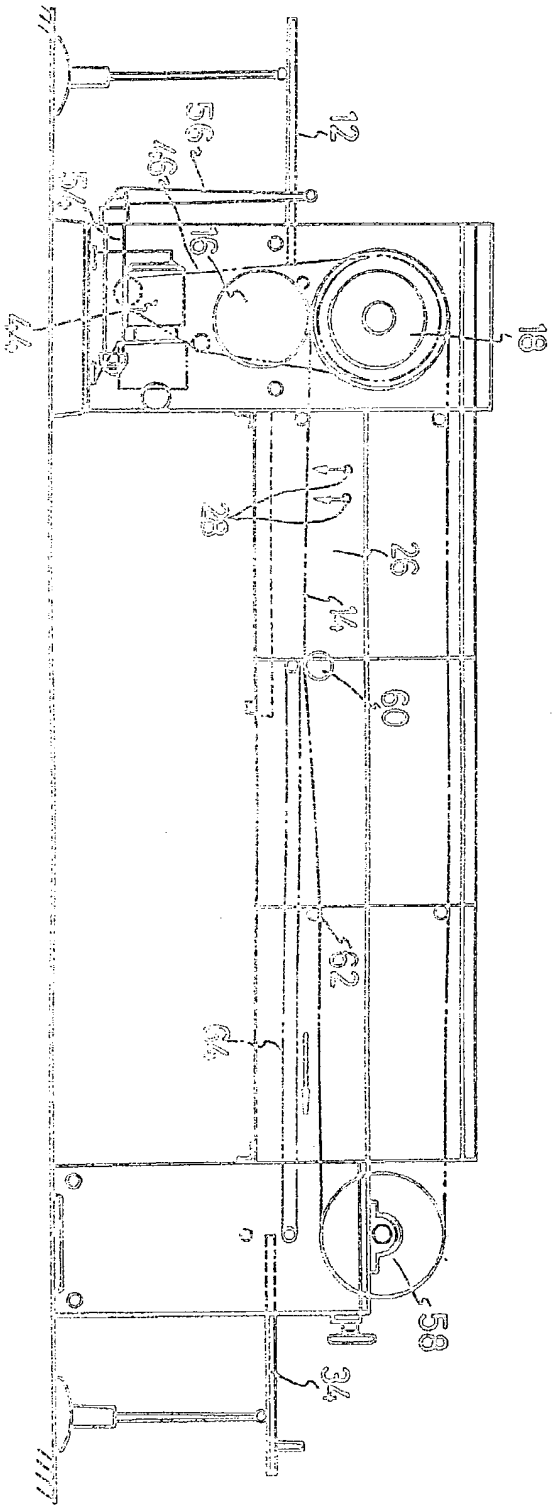


FIG. 2

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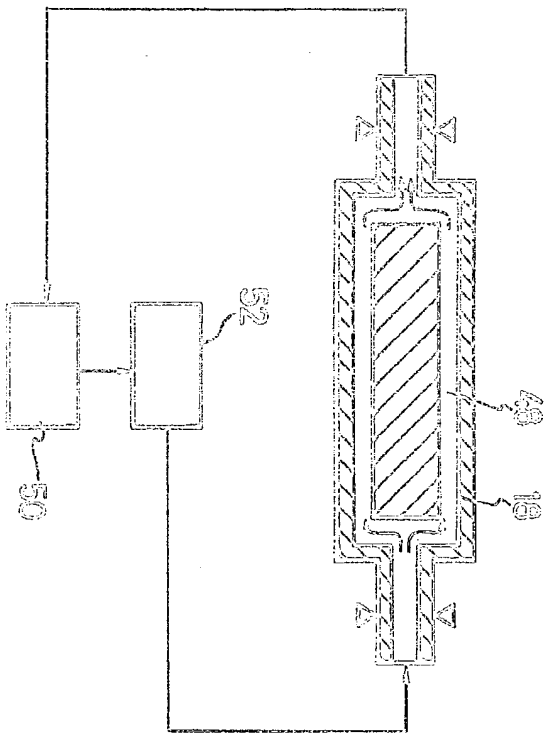


FIG.3

SPECIFICATION

**Apparatus for calendering sheet paper**

The present invention relates to calendering apparatus for sheet paper on which synthetic resin is coated, or more precisely, to calendering apparatus by which heat-melting and cooling effects are enhanced by a combination of main roller in which thermal fluid is circulated and cooling water shower.

Printed surface of sheet paper is calendered for finishing it beautifully and in a good sense. For calendering, synthetic resin coating such as polyvinyl chloride on the surface of sheet paper is once heated and melted. After such heat-melting process, the surface is cooled rapidly to obtain tension and luster on the surface. Therefore, in order to effect calendering sufficiently, quantity of heat which is rendered to or taken out of synthetic resin during heat-melting process and cooling process should strictly be managed.

In the prior art, infrared heater is fixed as heat source in the main roller which melts synthetic resin coating in cooperation with press roller. But, the temperature of such infrared heater rises to excess of 100°C. Accordingly, the heating temperature of such infrared heater should strictly be controlled in order to adjust the surface temperature of main roller. If not, printing ink and synthetic resin coating will be deteriorated. Rapid temperature control of such infrared heating means for calendering is difficult. Because, if an electric circuit of infrared heater in the main roller is cut off, the accumulated heat in the main roller will not be discharged instantaneously, but discharged gradually. Thereby, time delay of temperature fall of main roller causes defective product. Moreover, infrared heater can not be uniformly fixed in the main roller. Therefore, heat distribution on the surface of main roller can not be fixed and such irregular heat distribution causes defective product. Even if the thickness of main roller is added in order to equalize the heat distribution, heat response of main roller, in other words rapid temperature setting, becomes difficult. Furthermore, over 10 kw of electric power is needed for the infrared heater and, especially, large scale equipment for insulation of rotating main roller. Consequently, expensive electric costs and running costs are compelled.

As for the prior art cooling means, compressed air is flown against an object by blower. But, such blower generates noises and its dimension is very large. In conclusion, rapid heating and cooling cycle can not be achieved by the prior art calender apparatus. Its heat distribution is not uniform. Its dimension with preheat room is very large.

Accordingly, it is a main object of the present invention to obtain an improved apparatus for calendering sheet paper.

It is other object of the present invention to obtain calendering apparatus by which precise heat control is possible and which has good heat efficiency.

It is another object of the present invention to obtain calendering apparatus by which uniform heating and rapid calendering are possible.

It is further object of the present invention to obtain simplified and small-sized calendering apparatus.

To achieve these objects, calendering apparatus according to the present invention comprises; a main roller which is rotated by drive means provided near a sheet inserting table and has a hollow portion in which thermal fluid is circulated in order to heat an endless belt by conductive heat of thermal fluid, means for feeding thermal fluid to the hollow portion of main roller, a metallic endless belt the surface of which is polished and which is wound between the main roller and a delivery roller near a sheet discharging table, a press roller which is adjustably in contact with the main roller by way of the endless belt, a cooling room which is provided near the main roller and surrounds the endless belt and a cold water shower which pours cooling water to the inner surface of the endless belt in the cooling room for rapidly cooling the endless belt.

These and further objects of the present invention will be more clearly understood by the following descriptions with reference to the attached drawings. But, these are only examples of the invention and the present invention shall not be limited to those examples.

Fig. 1 is a chart showing an outline of calendering process by an apparatus according to the present invention.

Fig. 2 is a side view illustrating an embodiment of calendering apparatus according to the present invention.

Fig. 3 is a view showing a main roller and thermal fluid feeding means.

First of all, described is an outline of calendering process by an apparatus according to the present invention with reference to the attached drawings.

In a process indicated by numeral 10, sheet paper covered by synthetic resin is inserted between an endless belt 14 and a press roller 16 from sheet inserting table 12. The endless belt 14 is wound around a main roller 18 and is heated by thermal fluid feeding means. The endless belt 14 heats sheet paper covered with synthetic resin in cooperation with the press roller 16 in a process indicated by numeral 20. Numeral 22 indicates a processing process by the press roller 16. Sheet paper heated at a temperature below 100°C is then transferred to a cooling process 24 with and by the endless belt 14. In the cooling process 24, the endless belt 14 is cooled by water shower 28 when it passes through a cooling room 26 and such cooling effect is conducted to sheet paper. Then, sheet paper is peeled off from the endless belt 14 in a process 30 and, finally, piled on a sheet discharging table 34 in a process 32. Numerals 36 and 38 indicate, respectively, heating and cooling processes by the endless belt 14 which repeats these processes cyclically. Numeral 40 indicates a heating process of endless belt 14 by the main roller 18 and numeral 42 indicates a cooling process of the belt 14 by the water shower 28.

Next, calendering apparatus for sheet paper is detailed hereinunder with reference to Figs. 2 and 3.

Numeral 18 indicates the main roller for heating the endless belt 14 and the roller 14 is provided near the sheet inserting table 12 and is rotated by drive means 44 such as stepless varying-speed motor by way of a chain 46. The main roller 18 is made of a thin chilled

cast iron. The surface of the roller 18 is plated with hard chrome and, moreover, mirror-polished. The inside of main roller 18 is, as shown in Fig. 3, hollowed out in uniform thickness and thermal fluid is introduced to a hollow portion 48. Examples of thermal fluid are steam or heated oil. In the embodiment of Fig. 3, steam is adopted as thermal fluid. Steam generated by a boiler 50 which constitutes thermal fluid feeding means is led to the hollow portion 48 in the main roller 18 with the aid of pumping means 52 and, after heating the main roller 18, steam returns to the boiler 50 for reuse. The advantages of adopting steam as thermal fluid are that, unless over-heated temperature of steam does not exceed 120°C ~ 130°C. Accordingly, notwithstanding the rotation speed of main roller 18, temperature conducted to sheet paper and its synthetic resin cover is below 100°C. Therefore, printing ink or the synthetic resin cover will not be deteriorated and uniform calendering can be resulted. Furthermore, by leading steam of good heat efficiency into the hollow portion 48 of main roller 18, all area of main roller 18 can uniformly be heated and eveness of heat distribution can be accomplished. In addition, the circumferential temperature of main roller 18 can quickly be moderated by varying steam pressure. Moreover, the maximum steam pressure is sufficient about 5 kg/cm$^2$ and ordinary heavy oil may well be used so as to reduce fuel cost.

Above description is also applicable to the case in which an oil such as mineral oil is used as thermal fluid. A type of such oil is determined in consideration of its specific heat, thermal condictivity and duration so as to heat the main roller 18 properly. By adjusting the surface temperature of main roller 18 in this way, synthetic resin cover which was attached to the surface of sheet paper beforehand is uniformly melted and then adheres onto the surface of endless belt 14.

Press roller 16 is adjustably in contact with the main roller 18 by way of the endless belt 14. The roller 16 is a metal roller on which synthetic rubber is coated and is movably supported in the same direction of an axis of main roller 18. Numeral 54 indicates oil pressure generator for adjusting contact pressure of pressure roller 16 to the main roller 18. By moving a handle 56 of pressure generator 54, pressure roller 16 comes uniformly in contact with the main roller 18, adjusting contact pressure. Numeral 58 indicates a delivery roller which is symmetrically provided in relation to the main roller 18 at the side of sheet discharging table 34. The endless belt 14 is wound between these main roller 18 and delivery roller 58.

Endless belt 14 is a steel belt whose surface is mirror-polished. Synthetic resin coating of sheet paper adheres onto the endless belt 14 and is transferred by the belt 14. The sheet paper and its synthetic resin coating is heated and melted by the belt 14 and then rapidly cooled for calendering and, finally, sheet paper is peeled off from the belt 14 near the sheet discharging table 34. That is to say, the endless belt 14 is transfer means as well as heat conduction means of sheet paper and, thereby, an automatic calender apparatus is obtained. The endless belt 14, wound and rotated between the main roller 18 and the delivery roller 58, goes immediately into the cooling room 26 after heated by the main roller 18. Cooling room 26 is a compartment provided near the main roller and surrounds the moved endless belt 14. In the cooling room 26 are provided a plurality of cold water shower 28. Cooling water is poured from the water shower to the inner surface of the endless belt 14 so as rapidly to cool the endless belt 14. Thereby, sheet paper and its synthetic resin coating formerly melted is cooled rapidly for calendering by solidifying and mirror-finishing the coating. Water curtain wall may well be provided in place of cold water shower 28 in order to get rid of heat from the endless belt 14. Cooling water poured from the water shower 28 is, after washing the inner surface of the endless belt 14, drained from the apparatus through a drainage not shown. Without saying, such cold water can be reused after filtering and cooling them. Descriptions of filtrating means and pumps are omitted, because such means are well known.

Numerals 60 and 62 indicate guide rollers for tensioning the endless belt 14. Numeral 64 indicates a transfer belt which takes up sheet paper for sending it to sheet discharging table 34, as sheet paper is peeled off from the endless belt 14 when sheet paper is cooled rapidly. After passing through the delivery roller 58, the endless belt 14 returns to the main roller 18 without going through prior art pre-heating room.

As is described in detail, in calendering apparatus according to the present invention, the endless belt is heated by circulating thermal fluid such as steam in the main roller. Accordingly, surface temperature of main roller can be kept below 100°C, as temperature of thermal fluid does not exceed 120°C. Thereby, deterioration of printing ink or coated synthetic resin will not occur. Also, heat distribution of main roller is perfectly uniform, therefore, sufficient calendering without any unevenness can be effected. Further, as the endless belt is rapidly cooled by cooling water shower, no noise will be made. Moreover, beautiful calendering surface can be assured, as the synthetic resin coating is rapidly solidified. In addition, dimension of apparatus can extremely be minimized, as a pre-heat room is not at all necessary.

Many other applications and modifications are possible in relation to the present invention. The present invention is not limited to those shown and described hitherto.

CLAIMS

1. Apparatus for calendering sheet paper comprising;

. . . a main roller which is rotated by drive means provided near a sheet inserting table and has a hollow portion in which thermal fluid is circulated in order to heat an endless belt by conductive heat of thermal fluid,

. . . means for feeding thermal fluid to the hollow portion of main roller,

. . . a metallic endless belt the surface of which is polished and which is wound between the main roller and a delivery roller near a sheet discharging table,

. . . a press roller which is adjustably in contact with the main roller by way of the endless belt,

. . . a cooling room which is provided near the main roller and surrounds the endless belt and,

. . . a cold water shower which pours cooling water to the inner surface of the endless belt in the cooling

room for rapidly cooling the endless belt.

2. An apparatus according to claim 1, wherein steam is fed as thermal fluid by thermal fluid feeding means.

3. An apparatus according to claim 1, wherein oil is fed as thermal fluid by thermal fluid feeding means.

4. An apparatus for calendering sheet paper substantially as herein described with reference to and as shown in the accompanying drawings.

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